CLINICAL EVALUATION OF THE CERVICO-THORACIC SYMPATHETIC NERVE BLOCK IN THE MANAGEMENT OF SOME CEREBROVASCULAR ACCIDENTS

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The role of vasospasm in the pathogenesis of cerebrovascular accidents has been disputed. As early as 1919 Ricker [1] demonstrated that in focal cerebral disease vasospasm often occurs and can cause permanent arteriolar constriction. On the other hand, the researches of Florey,[2] Forbes and coworkers,[3, 4] Fog,[5] and Echlin [6] indicate that neurovascular mechanisms of the brain are too weak to maintain reflex vasospasm.

Data have been accumulated on this problem: on one hand are those who not only consider vasospasm to be an associated factor, but believe it is the fundamental factor in the pathogenesis of focal lesions and thus advocate therapeutic methods favoring cerebral vasodilatation; [7, 13] on the other are those who, on the basis of negative therapeutic results with sympathetic blocks, deny the importance of vasospasm in cerebrovascular accidents.[14, 17]

The purpose of this paper is to present our clinical and experimental results with cervical sympathetic block therapy in focal cerebrovascular disease.

Experimental Observations

Evaluation of the Cerebral Circulation by Observing Cerebrospinal Fluid Pressure. Carbon dioxide is one of the most potent cerebral vasodilator agents. Its effects are expressed in healthy normal subjects by an increase in cerebrospinal fluid pressure associated with increased cerebral blood flow. The behaviour of cerebrospinal fluid pressure was studied after the inhalation of 10 per cent CO_2 and 90 per cent O_2 in 3 normal subjects and in 15 patients with cerebrovascular disease. In normal subjects without vascular changes the inhalation of CO_2 causes a marked and prompt increase in cerebrospinal fluid pressure (approximately 20 to 30 cm. H_2O). In patients with cerebrovascular disease, the behavior of cerebrospinal fluid pressure to carbon dioxide was equivocal: slight changes (2 to 10 cm. H_2O) were observed in 5 patients, no change in 4 patients and marked changes in 6 patients. The differences can probably be attributed to the variable degree of vascular reactivity related to the anatomical changes present (sclerosis and arteritis), as previously suggested by others.[18, 19] The clinical course of these patients corresponded to the degree of cerebrospinal fluid pressure changes following sympathetic block, being more favorable in those in whom the cerebrospinal fluid pressure changes induced by CO_2 were greater (table 1). Sympathetic block therapy was ineffective in patients in whom CO_2 produced no variations in cerebrospinal fluid pressure.

Our results seem to confirm the possibility of evaluating pathological changes of the cerebral vessels by studying variations of cerebrospinal fluid pressure induced by CO_2 and at the same time furnishing a criterion for predicting the results of cervical sympathetic block. In our

TABLE 1

Cerebrospinal Fluid Pressure Changes Induced by Carbon Dioxide in Patients with Cerebrovascular Accidents and Results of Sympathetic Block Therapy

Case	Variations of Cerebrospinal Fluid Pressure after Inhalation of CO_2 (cm. H_2O)	Results of Cervical Sympathetic Block Therapy
1	0	Moderate improvement
2	+34	Marked improvement
3	+ 2	Slight improvement
4	0	No improvement
5	+10	Slight improvement
6	+ 6	Moderate improvement
7	0	No improvement
8	0	No improvement
9	+ 6	Slight improvement
10	+ 8	Slight improvement
11	+18	Fair improvement
12	+20	Marked improvement
13	+12	Slight improvement
14	+20	Marked improvement
15	+22	Marked improvement

Accepted for publication January 9, 1959. The authors are in the Division of Medicine and the Department of Anesthesiology, Mauriziano Hospital, Turin.

experience stellate ganglion block *per se* does not cause appreciable variations in cerebrospinal fluid pressure, thus supporting the hypothesis of Adams,[20] according to which sympathetic block causes a better redistribution of blood flow from the unaffected regions of the brain to those involved by the pathological process, rather than causing an absolute increase of the blood content of the brain.

Evaluation of the Cerebral Circulation by Observing Retinal Vessels. Vasodilatation of the retinal and ocular blood vessels following the interruption of the sympathetic pathways was observed by Hare (1839), Claude-Bernard (1859) and Horner (1869). Most agree that a parallelism exists between the behavior of cortical and retinal vessels and that ophthalmoscopy can indicate, to a certain point, the functional state of the vascular network of the brain.

Ophthalmoscopy was performed before and after cervical sympathetic block in 17 patients with focal cerebrovascular disease. A correlation was observed between the clinical improvement following block therapy and the changes observed in the fundus. Of the 8 patients in whom cervical sympathetic block produced excellent clinical results, an improvement of the ocular manifestations of the cerebral process occurred in 6; in 3 patients in whom moderate improvement was obtained, slight ocular changes were observed; and in the remaining 6 patients no clinical improvement nor ocular changes occurred. These observations confirm the functional relationship of cerebral and retinal vessels and stress their similarity in reaction to sympathetic block. Ophthalmoscopic examination before and after cervical sympathetic block can be considered a criterion for predicting the results of stellate ganglion block in cerebrovascular diseases.

Clinical Observations

Seventy-five patients with cerebrovascular accidents of various origin were treated by cervicothoracic sympathetic block. In many cases sympathetic block therapy was associated with the usual antispastic, vasodilator and anticoagulant agents. No incompatibility was observed between sympathetic block and anticoagulant therapy when the latter was kept within safe limits.

Stellate ganglion block was performed in most cases by the posterior approach, rarely by the anterior (paratracheal) approach. The anesthetic solutions used were procaine (1 per cent), pontocaine (0.1 per cent) and procaine-ammonium sulfate (PAB) delayed-action solution, in the usual dose for the technique used. The blocks were performed homolaterally to the cerebral lesion. A total of 10 to 15 blocks was usually performed, one or two daily for the first 4 or 5 days, then one every other day. The time lapse between the occurrence of stroke and the initiation of sympathetic block therapy varied according to the interval between the onset of stroke and hospitalization. Treatment could be begun within a few hours only in a small number of cases. Treatment was discontinued if no clinical improvement was observed after the first 4 or 5 blocks. The treatment had to be discontinued because of patient intolerance only in 3 cases. Of more than 600 blocks performed in these 75 patients one case of pneumothorax and one of hemopneumothorax occurred. Both healed satisfactorily.

The results were classified as: (1) complete—total regression of the clinical symptomatology or insignificant sequelae; (2) partial—partial improvement of the clinical manifestations or complete regression of only one of these (aphasia, motor paralysis, etc.); (3) none—slight or no improvement.

The results of treatment are presented in table 2, in relation to the time lapse between the onset of stroke and the initiation of sympathetic block treatment. The diagnosis of cerebral thrombosis, hemorrhage or embolism was made considering the classical *clinical* picture as described in the literature. In a few patients the diagnosis was confirmed at autopsy or, in the case of cerebral hemorrhage, by the presence of blood in the cerebrospinal fluid.

Complete recovery was observed in 8 (10.7 per cent) of these 75 patients, partial improvement was observed in 43 (57.2 per cent) and no change in 24 (32 per cent). The best results were obtained in patients with the classical clinical picture of cerebral thrombosis (complete or partial improvement in 84.6 per cent); less favorable results were obtained in cases of embolism (partial recovery in 40 per cent) and least favorable results in cerebral hemorrhage (partial recovery in 23 per cent).

Cervical sympathetic block proved most effective when performed within 72 hours of stroke.

The number of blocks required before evident clinical improvement varied from case to case. Improvement generally appeared after 4 to 5 blocks. No dramatic results were observed, but marked improvement often occurred within one hour of block and then disappeared according to the duration of effectiveness of the anesthetic solution. Improvement reappeared after subsequent blocks with gradually increasing intensity. One of the principle indications for the use of the PAB solution is in ganglionic block therapy, wherein it is desired to maintain the interruption of sympathetic pathways for long periods of time. By the use of PAB solution whose duration of action is more than 24 hours, it was possible to reduce the total number of blocks and to obtain persistent effects.

In no case was the picture aggravated by cervical sympathetic block, as described by some authors,[21–23] not even in cases of recent cerebral hemorrhage which, according to many, are a clear contraindication for early stellate ganglion block.

Discussion

The most common objection to sympathetic block therapy of cerebrovascular disease is the difficulty in establishing what part of the observed improvement is due to the treatment and what part to spontaneous improvement of the patient. The latter is not uncommon in these cases. While accepting this objection and admitting that rapid improvement, either spontaneous or due to palliative treatment, is possible, the effectiveness of sympathetic block therapy seemed undeniable in our patients in view of the intimate chronological relationship between sympathetic block and clinical improvement, the duration of which often corresponded to the length of action of the anesthetic used.

If it is admitted that stellate ganglion block is the factor responsible for the improvement of these patients, it must be accepted that the improvement of these patients is due to the resolution of vasospasm in the affected cerebral area. This hypothesis offers an explanation for the many failures and partial improvement observed in cases of cerebral embolism or hemorrhage. Sympathetic block cannot restore destroyed tissues. Its effects are limited to vasodilatation of collateral vessels, making it possible to save neurons situated peripherally to the lesion, which otherwise would die from tissue ischemia.

In no case were the dramatic changes described by Leriche,[8–10] Moore,[11] and Bonica [24] observed. Our patients improved progressively, in most cases after 4 to 5 blocks.

Although our series of patients with cerebral thrombosis is not homogeneous so far as age, sex, and severity and extension of the cerebral lesion is concerned, the high percentage of favorable results indicates this type of lesion to be most suitable for sympathetic block therapy. The poor results obtained in the patients with cerebral hemorrhage confirm data reported in the literature. However, in our experience stellate ganglion block has not proved dangerous in cerebral hemorrhage. This disagrees with the statements of Mackey and Scott,[25] De Takats [26, 27] and Risteen and Volpitto,[13] according to whom stellate ganglion block is contraindicated in recent cerebral hemorrhage inasmuch as it is theoretically capable of aggravating the bleeding. We did not perform stellate ganglion block in patients with extensive hemorrhage or with bleeding into the ventricles or meninges. Although the results of sympathetic block are poor in cerebral hemorrhage (only 3 partial recoveries), we agree with Mandl [28] and with Mackey and Scott [25] that improvement of certain secondary symptoms, such as mental symptoms and muscular spasm, can be obtained.

Our results in patients with cerebral embolism disagree with those reported in the literature. According to these, sympathetic block is most effective in cerebral embolism, especially when started early. In no patient in this series was a complete recovery obtained, even though 6 patients were treated within 24 hours of the accident. However, considering the innocuity of the method and the ineffectiveness of all other therapies, we believe that sympathetic block treatment is always justified, if necessary even with long and repeated courses of blocks, as advised by many.[8, 12, 13, 24, 27, 29–32]

Because of the lack of a control group, we cannot state that sympathetic block therapy modifies the mortality of these patients. Our

TABLE 2

RESULTS IN TREATMENT OF CEREBROVASCULAR ACCIDENTS WITH CERVICAL SYMPATHETIC BLOCK THERAPY

Diagnosis	Time Lapse Between Stroke and Initiation of Treatment	Number of Cases (Total)	Results		
			Complete	Partial	None
Thrombosis	0–24 hours	8	3	5	—
	25–72 hours	13	3	7	3
	73 hours–7 days	10	1	7	2
	8–30 days	15	1	12	2
	More than 30 days	6	—	5	1
	Total	52	8	36	8
Hemorrhage	0–24 hours	2	—	—	2
	25–72 hours	1	—	—	1
	73 hours–7 days	2	—	—	2
	8–30 days	4	—	3	1
	More than 30 days	4	—	—	4
	Total	13	—	3	10
Embolism	0–24 hours	6	—	4	2
	25–72 hours	2	—	—	2
	73 hours–7 days	—	—	—	—
	8–30 days	1	—	—	1
	More than 30 days	1	—	—	1
	Total	10	—	4	6
Total		75	8	43	24

impression is that the mortality rate is little if at all modified but certainly is not increased, as stated by Millikan, Lundy and Smith.[16] This group observed 8 per cent mortality in 60 cases of cerebrovascular accidents wherein stellate ganglion block was not performed as compared with 19 per cent of deaths in 27 patients in whom stellate ganglion block was performed. On the contrary, in the 11 fatalities in our series, mostly due to causes not directly related to the cerebrovascular accident, transitory but evident improvement of the neurological manifestations was observed.

Our current regimen of therapy is as follows: During the first few days of treatment we perform a sympathetic block every 8 or 12 hours or use the PAB anesthetic solution. This therapy can be discontinued when no improvement occurs after 5 or 6 blocks. In rare cases it may be necessary to render the effects of sympathetic block permanent in order to prevent a relapse or to transform a partial recovery into a complete success. In such cases the utility of surgical stellate ganglionectomy may be considered. This was done in 20 patients in this series. Chemical stellate ganglionectomy may also be indicated. We have used 6 per cent phenol, as described by Mandl in 1945, by Haxton in 1949 and confirmed by Bonica more recently. Our experience in this field is as yet too limited to be discussed here.

SUMMARY

Experimental results and clinical experience with cervical sympathetic block therapy in patients with cerebrovascular accidents has been presented. In 15 patients we have demonstrated that the inhalation of 10 per cent CO_2 and 90 per cent oxygen will lead to a rise in cerebrospinal fluid pressure in those patients who will be benefited by sympathetic block. We have also demonstrated in 17 patients a correlation between retinal vascular changes before and after sympathetic block and the degree of clinical improvement predictable from block therapy.

In 75 patients with cerebral thrombosis, hemorrhage or embolism, improvement was most striking following block in those patients suffering from thrombosis. The poorest results were in those patients who were diagnosed as having had a cerebral embolus phenomenon.

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